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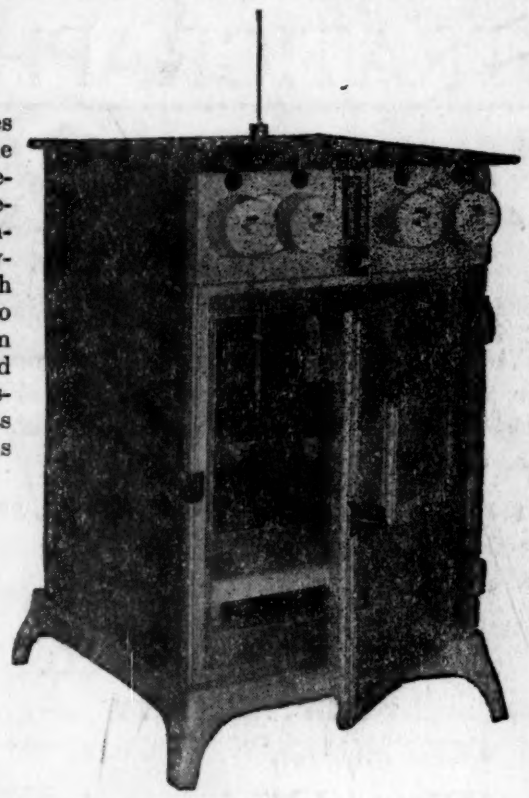

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THE FUTURE OF THE SIGMA XI[1]

IN a few weeks it will be thirty-one years since some students of Cornell University, feeling the injustice of the old-fashioned kind of education that gave all its honors, all its encouragement to the students of the liberal arts, planned an honor society in the sciences. They thought, as most of us now think, that not all of good was confined to Latin and Greek, that there was also merit in the natural sciences, that the student of geology or of engineering was as deserving of honors and of encouragement as the student of the classics. As they walked home from the commencement where the honors of Phi Beta Kappa had been liberally bestowed, they conceived a society that would recognize in an equal way the merits of the bachelor of science. And the Sigma Xi was born.

But higher education in America, as in all nations, has developed much since those days, and that exponent of the liberal education of those days has also changed. The Sigma Xi of 1886 would find little encouragement in most of our universities to-day, and we of the Sigma Xi may justly claim some of the credit for that change. The classical education of fifty years ago has but few proponents to-day, for science is now recognized as an essential part of any liberal education.

Perhaps some of us are claiming too much for science in education; I half believe that we are. When I received my bachelor degree, a good many years ago, my commencement speech was a diatribe on Latin and

[1] An address delivered to the initiates of the Yale chapter of the Sigma Xi, April 2, 1917.

Greek, which had exacted a full half of all my college work. But, I have frankly to admit that my debt to them is great, great because the science of those days was not a substitute for them, nor am I fully convinced that it yet is.

The Sigma Xi was founded, we may frankly admit, merely as a rival for the Phi Beta Kappa—perhaps there was a flavor of sour grapes in its origin! Has it justified its past? Is there justification for it to-day, and need for it in the future? Without reservation the answer to all these is yes. But, for the Sigma Xi of 1886 the need was brief. Science has won recognition as an essential part, though not the whole part of any liberal education. There was a time, not so very long ago, when studies of immediate bread-and-butter interest were debarred from the curriculum for the bachelor of arts degree as contaminators of a liberal education. I can remember a long and warm discussion in one of our large universities as to whether the study of human anatomy might safely be substituted for that of cat anatomy; not because the study of man was less worthy than the study of cats, but because the one was pursued for a practical purpose while the other was merely disciplinary. My colleagues of the language side feared that it would be, as indeed it was, a wedge to make education practical as well as cultural. Similar discussions are not often heard now in our faculty meetings. To preserve the degree of bachelor of arts in all its pristine aristocratic purity, the degrees of bachelor of science and of philosophy, and of I know not what else, were widely introduced for the proletariat in science. For a long time they were the penumbra of classical learning, and even yet in some places they have not won their full place in the sun. I hope that the time will soon be here when there shall be no distinctions anywhere between the student of Greek and the student of botany or chemistry, or of psychology. One is as useful in its way as the others, and has an equal place in liberal education, but not to the exclusion of others. This is now so evident that the statement would be a mere platitude, were it not that the Sigma Xi was founded expressly to help break down the distinction.

The Sigma Xi has long since ceased to look exclusively upon the other side of the Phi Beta Kappa shield. The ideals of our society are not those of its founders thirty years ago, when the simple recognition and encouragement of scientific studies were the most that it could do. Its higher ideal is now, as it has been for years, I can say with your unanimous approbation, the encouragement of productive scientific scholarship. The encouragement of scientific scholarship is but a part of its function. The student who, when he dons for the first time his academic gown, is able to talk learnedly of what his text-books and teachers have taught him about chromosomes, the mutations of *Œnothera,* dominant and recessive characters, the location of Cambrian rocks, the secret history of trilobites and dinosaurs, or the mysteries of ions and organic compounds, is a worthy candidate for membership with us, but he has not justified his right to full fellowship with the Spoudon Xunones until he has given evidence of his ability and desire to use that knowledge for the benefit of science. Our ultimate ideal, then, in a few words, is the encouragement of research. And the student may properly ask, what do you mean by research?

The word is something of a fetish with us. Is counting the number of feathers in a bird's wing, or the hairs in a mosquito's antenna research. Yes, if it leads the student better to understand the structure of all birds and all flies. Otherwise it might

as well be done by a properly constructed machine. We have been told that the mere accumulation of simple scientific facts never makes a leader in science, that, for instance, the collection of birds and bugs and brachiopods and their discrimination into species and subspecies is an inferior kind of research in natural history. But, every scientific man of repute in the past or present has begun in just that way, by the discovery and discrimination of scientific facts, however simple they may appear to others. Lamarck was a mere collector and namer of mollusks; Charles Darwin wasted years of his brilliant life in classifying cirriped crustaceans—I wonder how much those cirripeds had to do with natural selection, and I wonder how many of us would know a cirriped if we should meet one? Agassiz gave years of his life to the collection and study of poissons fossiles, and it requires no more acumen to classify fossil fishes than living bugs, for I have tried both. The collection and discrimination of mosquitoes was once a puerile pursuit. But, had there been no collectors and classifiers of mosquitoes, yellow fever would still be ravaging our seaports, and perhaps the Panama Canal would not now be a reality, and the safety of our nation endangered. Can any one see any possible relation between a mere entomological collector and the destruction of great cities by war? Had not Loewenhoek, in mere curiosity, found those organisms we call bacteria, and others wasted their time in studying and classifying them, there would have been no Pasteur, and antitoxins unknown. Is there no relation between such trivial pursuits, as some of our friends would call them, and typhoid fever?

I say, and say with deep conviction, that the ability displayed in the observation and discrimination of what often appear to us to be trivial things may be as great as that required for the formulation of far-reaching laws in science. Even the tyro can draw conclusions, that is, recognize laws, when facts are numerous enough, and the best of us can do nothing without facts. And the discovery of natural laws is sure to come when facts are numerous enough. It is the trained student who anticipates them. How many great discoveries or great inventions have uncontested claimants? Who was the discoverer of electricity, photography, telegraphy, telephony, aviation, or even evolution?

Let us not, then, deride the student because he is doing what we in our conceit think is unimportant. There are fashions in science as in everything else, and we are rather inclined to ridicule him who is not quite up to fashion. Shall we tell the candidate for honors in Sigma Xi that he must be in fashion? That research is research only when it leads to worldly recognition? No, train him aright, and nothing will be too trivial to merit his study. It is not *what* he does but *how* he does it that makes the leader in science as in everything else, for there is nothing small in science.

One of our noted chemists, not long ago, I have been told, after the publication of an important paper, when asked by the president of his college of what use his discoveries were to the world, replied that he hoped they had none. We would not wholly agree with him, because the ultimate end of all our research is the benefit of mankind, and there surely must be some practical use of every fact in science. He did emphasize, however, the first essential of every true scientist, the desire to learn new truths for the sake of truth.

Research ability I would define as the ability to observe, to discriminate, and to judge, coupled with an intelligence that is always asking the reason why. Given this ability to observe and to understand, and its possessor has the foundation for success, whether in science, in arts or in the

everyday affairs of life. Every day life is but a continual round of original research for every successful physician, lawyer, statesman or business man. And this is the highest aim of our society, to encourage the training of such students. As teachers our pupils look to us for inspiration and he only can give inspiration who knows the joy of research himself.

As a society for the mere giving of honors for scientific scholarship we have outgrown our past, and indeed that was our function only for a brief time. But we still have a duty to encourage scholarship, for without scholarship there can be no research. It is human nature to seek honors. Scientific men, like all others, from the humblest to the greatest, welcome them, whether it be membership in the Sigma Xi or in the National Academy of Sciences. When honors come as rewards for meritorious work accomplished they cheer and encourage; and they stimulate ourselves and others to higher efforts. We would not, if we could, abolish honors for scholarship from our society, we would not restrict them to accomplished research.

And our colleges and our nation need us for the higher work; never was there greater need for the work we can do, and these dangerous days are impressing us with that need. Until the millenium comes when we shall all live in peace and harmony, and like the dinosaurs grow big, fat and vulnerable and like them become extinct, the nation will need the utmost we can do in science.

Is it merely a coincidence that the life of the Sigma Xi has been nearly synchronous with the marvelous development of science in America? When this society was born there were but a few score of noted research men in science, and but one or two special societies in science. Now we number our alumni by the thousands, active research men by the hundreds, and scientific societies by the score. Then it was necessary for young men who would do things in science to go abroad, and chiefly to Germany, for their training. Who is there now who finds it necessary to go abroad for lack of suitable instruction here? It was not many years ago that I heard the justly famous Dr. Koch, of Germany, say that America was becoming the leader in medical education and that soon it would be necessary for foreign students to come here for their best training. We have been told so many times by our scientific friends abroad that we are precocious but still undeveloped in science that we have been inclined to believe them. But that time has passed. I say, not in boastfulness, but in conscious truth, that to-day America is doing more research work in nearly every branch of pure science than any other nation upon the globe. And the quality of our work suffers not in comparison. I have grown a little weary of the common assumption that we are still looking across the water for our inspiration and guidance in scientific research.

We are doing more work, we are doing quite as good work in pure science, not because we are any abler or better than other people, and especially Germany, but because ours is a democratic nation that gives to every one opportunity and stimulus; because we are less bound by precedent, because the teachers of our colleges and universities are less creatures of control. In Frankfurt-on-the-Main I was told, a few years ago, that the national government would not permit the privately endowed university they were founding there to appoint its own faculty. It reserved the privilege of making every professor a creature of the controlling government. Fancy what our progress would have been in America had a self-perpetuating cabinet of the national government had the power to

nominate every teacher in every college of our land!

These are some of the reasons, I am sure, for our remarkable development in pure science during the past forty years, some of the reasons why we may look forward to still greater progress in the coming years. Has our society had no part in this progress? Shall its part in the future be greater, or less? Do our colleges and universities still have need of us to strengthen, to sustain?

In one great side of science, however, for which our society stands, we, as a nation, have failed as compared with others, and especially Germany. Applied science, I mean, or at least some branches of it. England is awakening to its negligence in the past; never in the history of the empire has the scientific man of Britain been more appreciated than he is at present. And there is a new epoch for America coming soon. We have our Langleys, our Maxims, our Bells, Edisons and Wrights of whom we are proud, but our colleges have not had much share in their production, and we in the pure sciences are still a little inclined to look askance at them as the antithesis of that supposed ideal of our famous chemist. Has the Sigma Xi done all that it should in the past to encourage the applied sciences? Shall we give greater encouragement to the student who counts the bristles in a mosquito's proboscis or the plasmodia in its stomach than to him who applies that knowledge to the prevention of yellow fever? Does it require less ability, less research to observe, to discriminate, to judge in the construction of an airplane or a talking machine than to trace the fibers of a cerebral ganglion, or reconstruct the backbone of a dinosaur? Have we done what we should? Or shall we frankly restrict ourselves to the encouragement of research in pure science and leave its application for others to further, to encourage? I believe that the decision is now before us, and upon our answer depends much of the future of our society. Trained as a young man in two professions of applied science, and the most of my life given to research in science so pure that its application to things practical seems remote in the extreme, perhaps my sympathies with both are more pronounced than usual. I can see no difference in the quality of research that I gave to locating a railroad line, the treatment of a patient with measles, or the reconstruction of a paleozoic reptile. It would be a misfortune for us, I earnestly believe, to restrict ourselves to the encouragement of research in pure science.

A great future, I am sure, for science in America is its application, and the greater efficiency we reach in making use of the many discoveries of pure science for the amelioration and improvement of our conditions as a nation, the higher will be the honors, the greater encouragement we shall receive in the discovery of new facts and of new laws; the more honorable, the more appreciated will be the profession of the research student in pure science.

Because we as a society have not done all that I think we should have done in the encouragement of the applied sciences, numerous rival societies in our technological schools have come into existence. We are all working for the same objects, why should our efforts be weakened by rivalries? Why should we not all be united in a single great organization for the promotion of all branches and sides of science? I feel sure that the greater extension and the greater usefulness of the Sigma Xi has been hampered by our lack of accord in our ideals. Some of our chapters grant membership almost wholly for high scholarship, others exclusively to graduate students who have accomplished or are accomplishing meritorious research work. And this lack of unanimity has prevented, I am sure, the

greater extension of the society. We have but thirty chapters, an increase of but ten in the past ten years or more. There are at least a hundred institutions in America that need such encouragement as we can give. We have hesitated to extend our society, not because we are aristocratic, but because we earnestly desire to keep its ideals high, and know no way by which to ensure their preservation.

A step has been taken, one that I have hoped for for years, to define more precisely our ideals that we may entrust them fearlessly and safely to every institution where a few of us are gathered together. And I am still further encouraged to believe that in the end, even though it be slowly, it will lead to the results I have long hoped for, the extension of our society throughout our nation. Other organizations are doing much for the promotion of scientific research; ours is the nobler duty to train men and women for research in science, both pure and applied, to sustain, to encourage the university in the development of the science of the nation. Yale has done very much in the past, I am sure it will take its full part in the advancement of the future. Its ideals have always been high and they have been reflected in the chapter of the Sigma Xi. I can say with assurance that in no chapter of the society is the honor of election to membership greater.

In conclusion, I would say a few words to the initiates of this evening. You have pledged yourselves to uphold and sustain the ideals of the Sigma Xi. An honorable, a useful future lies before you. The world needs you as it has never needed such men as you before. Your vocation in life is more honorable than it ever has been before in the estimation of the world. I am sure that when you shall have reached my age, science will have won far greater honors yet for its earnest and sincere devotees, even as it has changed marvelously since the time when I was as young as you are.

New facts and new laws awaiting your discovery are as numerous as ever. Your work may be greater, but you are equipped to do that work more easily than we were a score or two years ago; your footsteps will be more direct, and the harvest that awaits your reaping is very, very great. And I would encourage you with the assurance that, no matter how humble that work may seem to you, if you have learned rightly to observe, to discriminate, and above all, to judge, there are no limits but your energy and your ambition to the heights you may climb.

Samuel W. Williston
University of Chicago

THE WORK OF DEAN H. L. RUSSELL

During commencement week his colleagues, friends and former students celebrated the twenty-fifth anniversary of the doctorate of H. L. Russell, dean of the College of Agriculture of the University of Wisconsin. In 1892 Johns Hopkins University honored Professor Russell by conferring this degree upon him. This year (1917) also marks the completion of twenty-four years of service to the University of Wisconsin. The last ten years of this period have been occupied in directing the activities of the College of Agriculture and the Experiment Station.

At the anniversary last week bound records of the results of the work accomplished by Dean Russell were presented to him. Three sturdy volumes there were—nearly two thousand pages.

"What Dean Russell has meant to Wisconsin and her farmers purely as an investment cannot be estimated, so extensive have been his activities and so far-reaching their results," said E. G. Hastings, professor of bacteriology, in speaking of the relation of Dean Russell's work to Wisconsin and her farming industry. Professor Hastings has been closely associated with Dr. Russell in his work as a bacteriologist, having worked with him when he was head of the department of bacteriology

and becoming head himself when the position was vacated by Dr. Russell. Professor Hastings said:

At the time Dean Russell was graduated from the University of Wisconsin in 1888, bacteriology was just being developed at the university. The history of what bacteriology has done for the control of many animal diseases, such as hog cholera, anthrax, black leg and bovine tuberculosis—diseases which formerly killed off thousands of head of live stock annually; of what it has done for the production of milk and the consequent lowering of the nation's death rate, especially among infants; of what it has done for the control of plant diseases, thereby saving millions of dollars to the country annually by increased crop production; of how the cheese industry has grown with increasing knowledge of bacteria, of what has been learned about the power of nitrogen-fixing bacteria, to enrich the soil and thus increase the crop yields, of how it has brought about improved sanitary conditions, and how it has helped with the canning industry and the preservation of food by other methods—the history of all this, which is the history of agricultural bacteriology during the past twenty-five years, speaks for the wisdom of spending money and time on the study of bacteriology in any state, and especially in a state with the dairy and crop record of Wisconsin.

The introduction of bacteriology at the University of Wisconsin was due to the efforts of Dr. Wm. Trelease, now of the University of Illinois, and to Dr. E. A. Birge, dean of the College of Letters and Science of the University of Wisconsin. The first announcement of courses in this subject was contained in the university catalogue issued in 1887–1888. It may seem strange that even before the science of "bacteriology" had received its name, it had found a place at this then far-western institution. This was due to the fact that those persons in charge of the university were men with the spirit of the pioneer. A pioneer must be a progressive man, a man who is always on the job, a man of good judgment as to the road to follow. Such men Wisconsin had.

Dean Russell became interested in bacteriology early in his career as a student, and under the influence of his teacher, Dr. Birge, he decided to go to Europe for instruction under the masters of what was then a comparatively new subject. He studied at Berlin while Robert Koch, the great pioneer of medical bacteriology, was actively engaged in teaching and investigating, and at Paris while Louis Pasteur was still busy in his laboratory. He returned to America and spent one year under Dr. William Welch of the Johns Hopkins University, thus completing the eighth year of his preparation for work—a long time in getting ready to work but the wisdom of this is shown in the things accomplished in the next twenty-five years.

About this time, in northern Germany and Denmark, the relation of bacteria to dairying, especially to the manufacture of butter and cheese, was beginning to attract attention. W. A. Henry, then dean of the College of Agriculture, with true pioneer spirit, realized that Wisconsin was destined to be a great dairy state if matters were rightly directed; it had great natural resources in lands, in climate and in men—for it had within its borders such men as Governor W. D. Hoard and Hiram Smith. Dean Henry's task was to make his institution do its share in the development of this industry. Looking back upon his work from the present day, no one can question his success.

Dean Henry decided that dairy bacteriology was something he must introduce in the work of the experiment and the college. It was most natural that his attention should be directed to the first student of the university to adopt it as a life work. Dean Russell came to the College of Agriculture in 1893, and immediately began work on the relation of bacteria to dairying and to bovine tuberculosis. The tuberculin test was just being introduced into this country, the Experiment Station herd being the first one west of the Alleghenies to be thus examined. This test revealed a sorry state of affairs; twenty-five out of thirty animals were found diseased. The herd was slaughtered. The new herd, which was assembled has been kept practically free from tuberculosis for twenty years. Animals have been introduced that later have reacted to the test, but the consistent and persistent use of the test has prevented any spread in the herd. True, expense has been involved in this work, but returns have been brought, both in money to the state and satisfaction to those in charge of the herd. Back in 1894, if the breeders of Wisconsin had adopted the advice given in Bulletin 40 of this station published that year, the state would have been in a far more enviable position as far as tuberculosis goes than at present.

Another subject which received much attention and which has accomplished an endless amount of good, was the study of the contamination of milk —the sources of such contamination and its prevention. The work done in pasteurization of milk outlined the method which is used so widely at the

present time for the treatment of market milk, a method that was not actually put into practice until ten or more years later because the industry was not ready for it. It is certain that the credit that should be given Dean Russell for his work on pasteurization of milk has not been bestowed because it came at too early a period in the development of the industry.

Various other fields of farming investigation have engaged Dean Russell's attention, including the study of bacterial diseases of plants, especially the black rot of cabbage. One of the lines of effort in which study of bacteriology has yielded results of great practical value was the relation of bacteria to the ripening of cheddar cheese. The discovery that cheese could be ripened at much lower temperatures than was previously thought possible was a by-product of scientific work, a by-product that adds hundreds of thousands of dollars to the income of the cheese industry in Wisconsin yearly, and will do so as long as cheese is made.

The state of Wisconsin has invested much money in work that has been accomplished by Dean Russell during these twenty-four years of service as a bacteriologist and director of the work of the College of Agriculture and Experiment Station. The question of importance to-day is the soundness of the investment and the returns it brings. Those who are best acquainted with the matter would cease to worry about the high cost of living and of dying if they could feel that their investments were one half as sound and would bring them one thousandth part of the returns that the state of Wisconsin receives from the money it has invested in this man.

THE PRIESTLEY MEMORIAL OF THE AMERICAN CHEMICAL SOCIETY

By resolution of the council of the American Chemical Society adopted at its meeting in Urbana in April, 1916, the president was requested to appoint a committee to devise and carry out a plan for a suitable memorial to Joseph Priestley. After careful consideration of various plans, the members of the committee desire to present the following recommendations to the Society:

1. That a bust portrait of Joseph Preistley be secured, to be a copy of the best available portrait; that this be retained as the property of the American Chemical Society, but be deposited as a loan in the National Museum in Washington. Also,

2. That a gold medal be awarded at intervals of probably more than one year for superior achievement in chemical research; the award to carry with it the requirement that the recipient shall deliver an address before the general meeting of the society at the time of the presentation or at such other time and place as the council of the society may direct.

Carful inquiry has convinced the committee that, in order to carry out these plans, a fund of at least $2,000 should be secured. It is requested that subscriptions be sent to the chairman or to any member of the committee. Contributions of sums from $1.00 upwards are asked.

Joseph Priestley was born at Fieldhead in England in 1733. Although educated for the ministry, he became noted as a teacher and lecturer on natural science, and especially as an investigator in chemistry, devoting his attention largely to the study of gases. Persecuted and shunned as a result of popular prejudice for his theological views as a dissenter from the Established Church, he migrated to America in 1794 and settled with his family in Northumberland, Pennsylvania. Here he established a laboratory and continued his work as an investigator in chemistry.

While famous throughout Europe and in America for his historical and philosophical writings, for his important work on the History of Electricity, and many other contributions to scientific literature, he is more especially known to modern chemists for his researches on the chemistry of gases, which culminated in 1774 in the discovery of oxygen, described in his treatise entitled "Experiments and Observations on Different Kinds of Airs."

He continued in America to be a contributor to scientific and theological literature until his death in Northumberland in 1804.

On July 31, 1874, many of the leading chemists of America met near the grave of Joseph Priestley at Northumberland to honor

the memory of the man who had discovered oxygen one hundred years before. In the account of the proceedings detailed in the *American Chemist* for 1874, we are told that a movement was there begun which led later to the establishment of the American Chemical Society.

And as the foundation of the American Chemical Society has been thus linked with the name of Joseph Priestley, it would seem proper that we should seek in some lasting way to commemorate his work as an investigator and philosopher and tireless searcher after truth.

It is earnestly hoped that the plans now proposed by the committee for a memorial will meet with approval and that we shall be able, by means of an adequate subscription fund, to render such honor as is due to the memory of John Priestley.

F. C. PHILLIPS, *Chairman*, University of Pittsburgh, Pittsburgh, Pa.
M. T. BOGERT, National Research Council, Munsey Bldg., Washington, D. C.
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C. F. CHANDLER, New Hartford, Conn.
F. W. CLARKE, U. S. Geological Survey, Washington, D. C.
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J. L. HOWE, Washington and Lee University, Lexington, Va.
J. H. LONG, Northwestern University, Chicago, Ill.
EDWARD W. MORLEY, West Hartford, Conn.
A. A. NOYES, Mass. Institute of Technology, Boston, Mass.
W. A. NOYES, University of Illinois, Urbana, Ill.
IRA REMSEN, Johns Hopkins University, Baltimore, Md.
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Committee

SCIENTIFIC EVENTS

A STRUCTURE POSSIBLY FAVORABLE FOR OIL UNDER THE CENTRAL GREAT PLAINS

IN consideration of the present great interest in oil prospects in the Great Plains region, the United States Geological Survey, Department of the Interior, has prepared a report giving all available information regarding the structure of that region. No oil or gas has been found in most of this wide area, but it contains several anticlines and domes like those which yield oil and gas in central Kansas, Oklahoma and Colorado, so that the conditions are encouraging for exploratory borings. Wells have been drilled at a number of places, but most of them have either been sunk where the structure was not favorable to the occurrence of oil or gas or have not been drilled deep enough to test all the strata.

The structure of the Central Great Plains north of latitude 37° has been investigated by geologist N. H. Darton, who has prepared a map showing by contour lines the location and configuration of a number of promising anticlines and domes. One of these domes lies on the Nebraska-South Dakota line northeast of Chadron, its crest being on White River. It may continue southward under the great sand cover in Nebraska to join an anticline of moderate prominence which crosses the Republican Valley just above Cambridge, Nebr., and extends into the western part of Norton county, Kans.

A local dome of considerable height occurs in Hamilton county, Kans., its crest being 6 or 8 miles southwest of Syracuse. It is on the flank of the largest dome in the Central Great Plains, which arches up the strata in Baca, Las Animas, and Bent counties, Colo., and adjacent parts of northern New Mexico. Its crest is under the Mesa del Mayo, on the state line. A dike of igneous rock not far west of this place contains petroleum, which undoubtedly had its source in some of the uplifted strata.

A dome east of Fort Collins, into which a drill has penetrated 3,900 feet, also presents structure favorable for oil, and when the drill reaches the beds that yield oil near Boulder it may find in them a possible reservoir. There

are some anticlines and domes in eastern South Dakota, but the strata above the granite and quartzite in that area are not thick enough to offer encouraging prospects.

A prominent anticline in Converse county, Wyo., with its crest east of Old Woman Creek, lifts an extensive series of sedimentary rocks not far southwest of the Black Hills. Another arch occurs on the west slope of these hills a few miles northwest of Moorcroft, and on its sides are oil springs from some underground source.

MEDICAL STUDENTS AND CONSCRIPTION

The *Journal* of the American Medical Association has obtained information regarding the draft numbers and numerical order of call of medical students. There were all told 13,764 medical students enrolled during the last session, of whom 3,379 graduated, leaving 10,385, made up of 4,107 freshmen, 3,117 sophomores, 2,866 juniors, and 295 seniors who were not graduated. Tabulated statistics regarding 5,909 or 56.9 per cent. of all undergraduate medical students based on direct replies to a questionnaire are as follows:

Class	Total Replies	Total to be Drafted		First Call		Second Call		Later Calls		Age Exempt	Aliens	Enlisted
		No.	%	No.	%	No.	%	No.	%			
Freshmen.....	2,016	1,579	78.3	412	26.0	283	20.3	884	55.9	384	14	39
Sophomores..	1,935	1,697	87.7	460	27.1	347	20.4	890	52.4	204	11	23
Juniors.....	1,458	1,356	93.0	418	31.2	275	20.3	663	48.1	77	6	19
Seniors.....	201	193	96.0	77	39.8	40	20.7	76	39.3	7	1	...
Not stated....	299	228	72.9	99	43.8	34	14.9	95	41.6	57	...	14
Totals.....	5,909	5,053		1,466		979		2,608		729	32	95
Percentages..	.....	85.5		29.0		19.4		51.6		12.4	0.5	1.6

While the table represents only a little more than 56 per cent. of the whole, it gives those interested an opportunity to estimate the effect of the draft on the different classes. As shown in the table, 5,053, or 85.5 per cent. of the students who have already replied, are subject to the draft, and of these 29 per cent. are included in the first call; 19.4 per cent. in the second call and 51.6 per cent. in later calls; 12.4 per cent. are exempt on account of age, 0.5 per cent. are aliens, and 1.6 per cent. have already enlisted. As will be noticed, 729 are exempt on account of age; of these 606 are under age, and 123 over the age limit. The *Journal* says that unless some arrangement is made, therefore, whereby these students are enabled to complete their medical training, classes in medical schools will be seriously depleted; the supply of physicians for the future will be seriously reduced, and this country will suffer from an error similar to that made in England and France where medical students were sent to the front. Furthermore, failure to exempt medical students from the draft will be a serious injustice to many, since a few months ago the Council of National Defense, with the apparent agreement of the War Department, urged medical students not to enlist in the Officers' Reserve Corps but to remain in college and complete their medical training. Had not that request been made, many students would have voluntarily enrolled in officers' training corps, where many of them would doubtless have been successful. Even though less than a third of the medical students of draft age will be included in the first call, a much larger proportion will be lost to the medical schools, since, in the absence of a definite understanding, many of the others will enlist voluntarily in the ranks, in ambulance corps or in officers' training corps. A definite decision on the part of the War Department relative to medical students is imperative. Unless such decision is made, not only will our civil hospitals lack adequate intern service, but the government will lose by the fact that those capable of skilled service will have been deflected to work which can be as well done by others.

PSYCHOPATHOLOGICAL EXAMINATION OF RECRUITS

According to a press bulletin men of the National Guards of the various states and of the new draft army will be subjected to thorough mental examinations by expert neurologists and psychopathologists at the concentration camps before sailing to France, to weed out the mentally and nervously unfit, whom the experience of France, Britain and Germany shows have proved useless and a burden at the

front. Not only are these examinations expected to weed out those whose nervous systems are broken down, and the feeble-minded or imbecile, but they will hinder the draft evaders from feigning nervousness or mental sickness. Not only will these expert neurologists and psychopathologists examine the men at the cantonments, but they will go to the front with the men and establish base hospitals adjacent to the orthopædic base hospitals.

Ten of the leading psychopathologists of the country have been selected for the starting of this branch of service. They are Dr. E. E. Southard, director of the psychopathic hospital of Boston; Dr. Robert M. Yerkes, professor of comparative psychology at Harvard University; Dr. August Hoch, director of the psychiatric institute, New York City; Dr. Adolf Meyer, director of the Phipps Psychiatric Institute, Baltimore; Dr. Albert M. Barrett, director of the State Psychopathic Hospital, Ann Arbor, Mich.; Dr. William A. White, superintendent of the Government Hospital for the Insane, Washington, D. C.; Dr. William E. Fernald, superintendent of the State School for the Feeble Minded at Waverley, Mass.; Dr. Thomas W. Salmon, medical director of the National Committee for Mental Hygiene of New York City, who has gone to England for observation; Dr. Joseph P. Collins, of the New York Neurological Institute, New York City, and Dr. T. H. Weisenburg, president of the American Neurological Association of Philadelphia.

There are five clinics where leading specialists and doctors are preparing for the work. They have been assigned by the government for special teaching in neurology and pschiatry for commissioned men in the Medical Reserve Corps. The courses of six weeks' duration, the first course just being completed, are being given at the following clinics: The Psychopathic Hospital, Boston; Phipps Psychiatric Clinic, Baltimore; State Psychopathic Hospital, Ann Arbor, Mich.; the Neurological Institute, New York City, and the Psychiatric Institute, Ward's Island, New York.

THIRD NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES

THE third national exhibition of chemical industries will be held in the Grand Central Palace, New York City, during the week of September 24. Many of the exhibits will have to do with the uses of chemistry in the making of war materials, and there will be a special section devoted to the South which will be known as the Southern Opportunity Section. Dr. Charles H. Herty, chairman of the advisory committee of the exposition, will deliver the opening address on Monday, September 24, at two o'clock. Professor Julius Stieglitz, president of the American Chemical Society; Dr. Colin G. Fink, president of the American Electro-Chemical Society, and Dr. G. W. Thompson, president of the American Institute of Chemical Engineers, will speak before different sections of the convention. Other speakers on the program include W. S. Kies, vice-president of the National City Bank, who will talk upon "The Development of Export Trade with South America"; Professor Marston Taylor Bogert, chairman of the chemistry committee of the National Council, whose subject will be "The operation and work of the National Research Council for the national weal," and Dr. L. H. Baekeland, of the Naval Counsulting Board, on "The future of the American chemical industry."

One day will be devoted to a symposium upon the national resources as opportunities for chemical industries, and among the speakers will be: Mr. C. H. Crawford, assistant to president of Nashville, Chattanooga & St. Louis Ry.; Mr. V. V. Kelsey, chemist-industrial agent, Carolina, Clinchfield & Ohio Ry.; Dr. E. A. Schubert, mineralogist-geologist, Norfork & Western Railway; Dr. T. P. Maynard, mineralogist-geologist, Central of Georgia Ry. and Atlantic Coast Line Ry.; Dr. J. H. Watkins, geologist, Southern Railway.

The motion-picture program will be one of wide interest. The American Cyanamid Company and General Electric Company have already arranged to supply their films. The Bureau of Commercial Economics at Washington will supply many toward completing

the range of industrial films. At the last exposition two floors of the big building were occupied by 187 exhibitors. This year three floors, possibly more, will be occupied. Already the list of exhibitors contains 250 names of companies entering every field of industry.

SCIENTIFIC NOTES AND NEWS

Surgeon-General Gorgas, Dr. Franklin H. Martin, head of the Medical Bureau of the Council of National Defense, and their staffs, and a large number of army and reserve medical officers visited on August 12 the Rockefeller Institute for Medical Research, where they saw demonstrations of the medical and surgical practises which the institute has developed.

Surgeon-General Gorgas, of the army, reorganizing the Veterinary Corps, has selected the following veterinary surgeons as an advisory board: Dr. C. J. Marshall, Pennsylvania; Dr. David S. White, dean of the college of veterinary medicine, Ohio State University, Columbus; Dr. Louis A. Klein, dean of the school of veterinary medicine, University of Pennsylvania; Dr. V. A. Moore, dean of the New York state veterinary college, Cornell University, and Dr. John R. Mohler, assistant chief of the Bureau of Animal Industry, Washington.

A research committee to cooperate with the National Research Council has been appointed at Brown University, including from the faculty Professors Carl Barus, Albert D. Mead, Roland G. D. Richardson, John E. Bucher and Frederic P. Gorham; from the university corporation, Chancellor Arnold B. Chace and Edwin Farnham Greene, treasurer of the Pacific Mills; from the alumni, J. B. F. Herreshoff, of the Nichols Chemical Company; Charles V. Chapin, M.D., of the Providence Board of Health; John C. Hebden, of the Federal Dye Stuffs Corporation, and Frank E. Winsor, of Providence. The committee will prepare a survey of research already in progress at Brown University, and assist in a national census of research work in the United States. It will endeavor to broaden the conception of scientific research, to cooperate with industrial corporations, and to establish research fellowships so as to train promising young men and women for important positions in manufacture and in the government service.

Professor William Campbell, of Columbia University, New York, is serving as consulting metallographist at the New York navy yard.

Dr. Hardee Chambliss, chemical director of the Commercial Acid Company of St. Louis, has been commissioned major in the ordnance section of the Officers' Reserve Corps.

The British Fuel Research Board, with the sanction of the Committee of the Privy Council for Scientific and Industrial Research, has appointed a committee of inquiry into the utilization of Irish peat deposits. The following appointments have been made to the committee: Sir John Purser Griffith (chairman), Professor Hugh Ryan, Professor Sydney Young, Mr. George Fletcher and Professor Pierce Purcell (secretary).

It is stated in *Nature* that grants have been made out of the Dixon fund of the University of London for the year 1917–18 as follows: £25, Mr. Nilratan Dhar, for research on temperature coefficients of chemical reactions; £30, Mr. H. R. Nettleton, for researches on the measurement of the Thomson effect in wires; £20, Dr. D. Ellis, towards the cost of publication of a book on "Iron Bacteria"; £100, Mr. Birbal Sahni, to enable him to carry out botanical investigations at Cambridge.

The Asiatic Society of Bengal has awarded the Barclay memorial medal to Col. H. H. Godwin-Austen, for his work in biology.

Dr. Edward G. Birge has resigned as director of the state bacteriologic laboratory at Jacksonville, Fla., and has been succeeded by Dr. Burdett L. Arms, Montgomery, chief bacteriologist of the Alabama State Board of Health.

Dr. Edward S. Godfrey, Jr., has resigned as director of the Illinois Bureau of Communicable Diseases of the State Board of Health, to accept a position in the sanitary de-

partment of the New York State Department of Health. He has been assigned to the district comprising Albany and Rensselaer counties.

THE Ellen H. Richards Memorial Fellowship, offered jointly by the trustees of the Memorial Fund and the University of Chicago, has been awarded to Minna C. Denton, B.S. and A.M. (Michigan). Miss Denton's teaching experience at Milwaukee-Downer College, Lewis Institute and Ohio State University has been supplemented with recent work as fellow in physiology of the University of Chicago. She is at present at work on the alterations in nutritive value of vegetable foods due to boiling and canning. The fellowship carries a stipend of $500 and tuition fees for the year 1917–18.

ASSISTANT PROFESSOR J. WENDELL BAILEY, of the General Science School of the Mississippi Agricultural and Mechanical College, has accepted an appointment with the U. S. Department of Agriculture, Bureau of Entomology, and is engaged in research work on insects affecting cereal and forage crops. He is now at Tempe, Arizona, in the irrigated section of the Salt River Valley.

DR. W. S. MILLER, professor of anatomy in the University of Wisconsin, recently delivered an address on "The architecture of the lung," before the faculty and students of the graduate summer quarter in medicine of the University of Illinois.

WE learn from the *Journal* of the American Medical Association that a large party of medical men and others who were delegates from the medical faculty of the University of Buenos Aires and other medical organizations of Argentina sailed to Rio de Janeiro recently to visit the profession at Rio. The party bore with them a large bronze tablet to be placed in the Bacteriologic Institute founded and directed by Oswaldo Cruz. It represents Argentine medical science, humanity and hygiene decorating with laurel the memorial inscription to the great hygienist who cleared Rio de Janeiro of yellow fever. The physicians were welcomed by the authorities as guests of the nation during their stay. They also presented the Museum of Natural History with plaster casts of the five skulls on which F. Ameghino based his anthropologic theory of the fossil American man.

THE geology and paleontology committee of the National Research Council has passed the following resolution:

We desire to record our keen sense of loss in the death of our colleague, Dr. William Bullock Clark.

Since the organization of this committee, six months ago, Dr. Clark's extraordinary executive ability has been devoted without reserve to its aims, and the work which he organized, as chairman of the important subcommittee on roads and road materials, has proceeded with celerity and accuracy over the entire Atlantic seaboard from Maine to Florida.

He gave an invaluable service to his country with intense devotion, and we feel that he has made the supreme sacrifice.

THE death is announced at the age of seventy-four years of Robert Helmert, professor in the University of Berlin and director of the Geodetic Institute.

DR. THEODOR KOCHER, professor of surgery at the University of Berne, has died at the age of seventy-six years. Dr. Kocher was distinguished for his work on goiter and in other directions. The Nobel prize which he received in 1909 he gave to the University of Berne for medical research.

M. PAUL HARIOT, author of works on fungi and algae, and for many years in practical charge of the collections of the lower plants at the Muséum d'Histoire Naturelle of Paris, died on July 5, from diabetic complications. The broad-minded liberality and tireless patience with which M. Hariot always placed the treasures of his department of the museum at the service of the scientific men of the world will long be held in grateful remembrance by a considerable number of American botanists.

PROFESSOR J. H. BARNES, agricultural chemist to the government of India, and late principal of the Government College of Agriculture, Lyallpur, Punjab, died in India on June 2.

Mr. Stanley Baldwin has stated in the House of Commons that the question of the suspension of the issue of the *Kew Bulletin* had been considered by the Select Committee on Publications and Debates' Reports, and that it was decided to recommend that the *Bulletin* should be continued, but with due regard to economy. Certain classes of information, though doubtless of scientific interest, can, it is thought, be postponed without detriment to the welfare of the state.

UNIVERSITY AND EDUCATIONAL NEWS

According to the *Experiment Station Record* appropriations made by the state legislature for the South Dakota College and Station include $80,000 for an armory, $100,000 for the completion of Agricultural Hall, $10,000 for a health laboratory, $10,000 for the manufacture of hog cholera serum, $20,000 for a fireproof stock judging pavilion, $3,000 for a poultry department, $10,000 for the purchase of pure bred live stock, and $5,000 for feeding experiments with live stock. This is the first appropriation made by the state for experimental work.

Professor E. V. McCollum has resigned his position as professor of agricultural chemistry at the University of Wisconsin, to take charge of the department of chemistry of the new school of hygiene and public health, which the Rockefeller Foundation has established in connection with the medical school of the Johns Hopkins University.

Professor Frank C. Becht, assistant professor of pharmacology in the University of Chicago, has been appointed professor and head of the department of pharmacology in Northwestern University Medical School, succeeding Professor Hugh McGuigan, who has become professor of pharmacology in the University of Illinois.

Dr. A. E. Lambert has been appointed professor of histology and embryology in the college of medicine of the University of Vermont. Dr. M. W. Hunter, instructor in medicine, has resigned and Dr. Fred E. Clark, assistant professor of pathology, has received a year's leave of absence.

Professor H. Halperin, of Vanderbilt University, has been appointed assistant professor of mathematics at the University of Arkansas.

Dr. Percy Kendall Holmes, of the University of Cincinnati, has been appointed director of physical education in Ohio Wesleyan University.

Mr. G. Gerald Stoney has been appointed professor of mechanical engineering in the Manchester School of Technology.

M. Lucien Poincaré, director of higher education in France, has been appointed vice-rector of the University of Paris, in succession to M. Liard.

M. Moureu, member of the French Institute, professor in the school of pharmacy and director of the editorial board of the *Revue Scientifique,* has been appointed professor of organic chemistry in the Collège de France.

DISCUSSION AND CORRESPONDENCE

THE COST OF ROAST PIG

Charles Lamb, in his "Dissertation on Roast Pig" relates that, according to an ancient manuscript, the hut of a Chinese swineherd taking fire, a litter of newly farrowed pigs perished in the conflagration. Seeking to find if life remained in any of them, the swineherd burned his fingers on the hot body of a pig. To alleviate the pain he naturally put his fingers into his mouth and so discovered the delicious flavor of roast pig. The taste spread rapidly and shortly all China was ablaze with burning pig pens sacrificed for the sake of producing the new delicacy.

In the food crisis with which the world is apparently confronted, roast pig may stand for the supply of animal products in general, and our methods for producing them hitherto have not been altogether unlike that for roasting pigs attributed to the Chinese. At this juncture, it seems pertinent to inquire whether our practises in this respect do not need to be modified so as to contribute more effectively to the feeding of the nations.

Roast pig, to those who like it, is not only a delicacy but a valuable article of diet, but nevertheless, as the Chinese presumably came to realize, it is possible to pay too high a price for it, and while a proposal to restrict rather than to promote meat production in the present crisis may appear both irrational and unpatriotic it may nevertheless be in the interest of true food economy.

This is because of one cardinal fact which the advocates of the multiplication of farm live stock, the prohibition of the slaughter of young animals, etc., overlook. That fact is that not only must the meat or milk producing animal be fed (and even this appears to be forgotten at times) but that the conversion of feed into animal products is a process of relatively low efficiency.

Man needs food primarily as fuel to supply the energy for his activities and secondarily to furnish the repair material (protein) for the bodily machinery. An active adult requires daily some 4,000 calories of energy, the amount varying more or less according to the amount of physical work done. He can get this energy from either vegetable or animal products. He may make his wheat or corn into bread and use that bread as body fuel, or he may feed them to animals and consume the resulting meat or milk. The latter are excellent body fuels and are desirable ingredients of the dietary but their production from grains is a very wasteful process. It may be roughly estimated that about 24 per cent. of the energy of grain is recovered for human consumption in pork, about 18 per cent. in milk and only about 3.5 per cent. in beef and mutton. In other words, the farmer who feeds bread grains to his stock is unconsciously imitating the Chinese method and is burning up 75 to 97 per cent. of them in order to produce for us a small residue of roast pig, and so is diminishing the total stock of human food.

Now most of us like roast pig and its production in this way has doubtless been economically justifiable in years past when our food supply was vastly in excess of our needs. To-day the case is different. No longer can we continue to take the children's bread and cast it to the brutes. If our meat supply is to be maintained or increased it must be in some other way. All the edible products which the farmer's acres can yield are needed for human consumption. The task of the stock feeder must be to utilize through his skill and knowledge the inedible products of the farm and factory such as hay, corn stalks, straw, bran, brewers' and distillers' grains, gluten feed, and the like, and to make at least a fraction of them available for man's use. In so doing he will be really adding to the food supply and will be rendering a great public sevice. Rather than seek to stimulate live stock husbandry the ideal should be to adjust it to the limits set by the available supply of forage crops and by-product feeding stuffs while, on the other hand, utilizing these to the greatest practicable extent, because in this way we save some of what would otherwise be a total loss. In particular the recommendation to raise more hogs seems to call for some qualification. It is indeed true, as several have pointed out, that the hog can make more pounds of edible meat from a given amount of concentrated feed than any other class of live stock. The point is that with the present demand for bread grains we can not afford the cost of the conversion. So far as hogs can be raised on forage and by-products the recommendation is sound, and this animal can play an important part in utilizing domestic and other wastes, but the hog is the great competitor of man for the higher grades of food and in swine husbandry as ordinarily conducted we are in danger of paying too much for our roast pig. Cattle and sheep, on the other hand, although less efficient as converters, can utilize products which man can not use and save some of their potential value as human food. From this point of view, as well as on account of the importance of milk to infants and invalids, the high economy of food production by the dairy cow deserves careful consideration, although of course the large labor requirement is a counter-balancing factor.

At any rate, it is clear that at the present time enthusiastic but ill considered "boom-

ing" of live stock production may do more harm than good. If it is desirable to restrict or prohibit the production of alcohol from grain or potatoes on the ground that it involves a waste of food value, the same reason calls for restriction of the burning-up of these materials to produce roast pig. This means, of course, a limited meat supply. To some of us this may seem a hardship. Meat, however, is by no means the essential that we have been wont to suppose and partial deprivation of it is not inconsistent with high bodily efficiency. Certainly no patriotic citizen would wish to insist on his customary allowance of roast pig at the cost of the food supply of his brothers in the trenches.

H. P. Armsby

State College, Pa.,
June, 1917

A NEW CONTRIBUTION TO AMERICAN GEOLOGY

Under the heading "Work going on at Kilauea Volcano" there was published in Science of September 12, 1913, an account from Hawaii by Mr. Geo. Carroll Curtis, of the field work, cirkut and kite camera surveys being conducted in the great active crater, in connection with the construction of a naturalistic model for the geological department of Harvard University.

After four years of continuous effort this work has been completed and installed in the university museum. While the size and time required distinguish it, the principles it involves of faithful and expressive reproduction of the earth surface is of special significance, as it seems to mark a distinct progress in the complex subject of representing our earth in true relief and character. A single glance at the great model is convincing, for in looking upon this vast collection of accurate data, one receives the impression that he is viewing the outdoor field itself! The model looks like the actual ground because it has been made like it, an immense amount of information never before collected having been incorporated from the special surveys. This is a signal triumph in the truthful interpretation of a splendid type of geological structure such as Kilauea presents. It clearly indicates the novel and broad interest which awaits the earth sciences in the reproduction of their museum natural history specimens through the medium of serious work in land relief.

The longest time previously given to any work we have had of this nature, was two years, in the naturalistic reproduction of the coral island Bora Bora,[1] under the instigation of Alexander Agassiz. It was made to illustrate the typical "high coral island." This work, completed in 1907, was the first in the land where the necessary photographic survey and special field work were employed to truthfully reproduce a land form type, and marked the introduction of the naturalistic or landscape model in American exhibition. The character of the work was illustrated by the photographs made from it, bearing a surprising resemblance to those taken on the actual ground, a thing previously unlooked for in our land reliefs. This unique contribution to the progress of earth science is still considered the most complete exposition of a coral island known, and as the pioneer in naturalistic land relief (the completest expression which science and art can give of the earth's surface) will always remain a most significant piece of work.

The Kilauea model represents the progress of the intervening decade, in the new and developing art of the accurate reproduction of the surface of the planet, and is the culmination of the unique experience which has come through a training in both geology and in art, which Mr. Curtis has given to this profound though much misrepresented work of earth relief. Against precedent he has attempted to make a profession rather than a business of a work which calls for treatment adequate to the dignity of natural science. Valuable as may be the individual models to which Curtis has given so much time and study, it is in the establishment of a standard more in keeping with that called for by the natural sciences and by the meaning and interest of the face of our earth, that his most significant achieve-

[1] Darwin, "Structure and Distribution of Coral Reefs," p. 4.

ment lies. That this standard is to-day probably second to none is to be seen in the Kilauea model which presents several important innovations in the development of land relief, including the application of cirkut panorama and aerial photography and the cycloramic background.

The Kilauea undertaking marks the advent of the American geologist into the work most complete and effective of any known for representation of the immense forms with which he deals. Some conception of what this subject, calling for the best that modern science and art can offer, has in store, may be had from statements of those who have visited the active volcano and maintain that a better comprehension of the huge crater may be obtained from the model in Cambridge than in Hawaii itself, owing to the vast dimensions of the Kilauea region. What is yet in store for the earth sciences through the naturalistic reproduction in relief of remaining great types of land form, should give some measure of the value of this contribution.

ROBERT W. SAYLES.

GEOLOGICAL SECTION,
HARVARD UNIVERSITY MUSEUM

BOTRYTIS AND SCLEROTINIA

CONNECTION has recently been established between an apparently undescribed species of *Sclerotinia* occurring in woods in the upper end of Van Cortlandt Park on the rootstocks of wild geranium and a species of *Botrytis* occurring on the roots and rootstocks of the same host. The field observations were made by the writer and the culture work was conducted in the New York Botanical Garden by Professor W. T. Horne. A joint paper will be offered on the subject in connection with the celebration of the fiftieth anniversary of the Torrey Botanical Club this fall. As it will be several months before this paper can appear in print, it was thought advisable to call attention to the facts at this time. While connection between *Botrytis* and *Sclerotinia* has been claimed by DeBary and predicted by more recent workers, this is one of the first and possibly the first case in which the connection has been definitely established by culture experiments.

FRED J. SEAVER

THE NEW YORK BOTANICAL GARDEN

QUOTATIONS

A BRITISH REPORT ON INDUSTRIAL RESEARCH IN AMERICA

THE Advisory Council for Scientific and Industrial Research has issued the first of a series of papers in which, under the title of Science and Industry, it intends publishing information of value to manufacturers. The intention was announced in the report of the Committee of the Privy Council, of which an account appeared in these columns; and the present instalment by Mr. A. P. M. Fleming, of the British Westinghouse Company, on industrial research in the United States, is so full of information and practical suggestion that engineers will learn with regret that there is little prospect of further instalments appearing during the war.

The paper differs from much that issues from the Stationery Office in being essentially a practical work, not loaded with statistics and theoretical considerations. It is a plain statement of facts and practical suggestions very important to industry, set out for British manufacturers by one of their own body in such a way that what it describes and what it suggests can readily be understood; it is illustrated by 85 half-page or full-page blocks, and published—at the public cost—at the price of 1 s. No appreciable expense either of time or brain-stuff or money stands between the message of the volume and the public for whom it is meant; and while there is no point in summarizing what can be easily acquired and digested, some of its facts and the consequences that they suggest are worth consideration.

The modern tendency of American manufacture to research may perhaps be seen most strikingly in what is being done by manufacturing and similar corporations themselves. Examples are to be found alike in the mechanical, electrical, and chemical industries, and are on every variety of scale, up to the £30,000 per year to which the Eastman Kodak Com-

pany devotes something under 1 per cent. of its profits, and the £80,000 to £100,000 a year spent by the General Electric Company of Schenectady. Mr. Fleming gives particulars of what is being done by each of some twenty corporations, but the list could easily be made very much longer. Most of these laboratories have sprung up in quite recent years; and their number is constantly increasing. The increase is not merely in number. It is as remarkable in its growing breadth. The laboratories of these firms undertake not merely the routine of testing of materials and products and the more or less empirical adventures after new products that was formerly the business of a works' laboratory. At the one end of the scale they carry out experiments on the discovery of new products and the elaboration of new designs into the full manufacturing scale, and the laboratory supplies the needs of the market as if it were itself a works, until they outgrow the capacity of its plant and call for a new works of their own. At the other end of the scale they undertake inquiries into questions of pure science, of the solution of which no one can see any industrial application. They keep men investigating such problems constantly and perseveringly, and give them admirably equipped laboratories for the purpose. This sort of thing is being done in works after works, and every year adds to their number and the elaboration of their equipment. All the time, in spite of the enormous sums that are being spent on what at first sight is not only unproductive work, but work which tends to subordinate the wholesome rule of practise to the fantastic and costly demands of laboratories, the thing pays. The fact that the habit has grown so far is good *prima-facie* evidence that it must pay, for American business houses do not fling good money after bad. But there is no need to depend on inference or *prima-facie* evidence. The individual experience of those who have tried it shows that in fact it has paid, and the air in America is thick with plans to extend the practise of applying science to help industry; for great as is the extent of what has been done already, it is only a tiny fraction of what in American industry there is still room and the intention to do.

Side by side with these corporations and firms three groups of institutions are working to the same ends. Mr. Fleming quotes a dozen or more separate industries with their trade associations, each of which is undertaking research for the common benefit of their members; sometimes in their own common research laboratories, sometimes in those of their members, sometimes through university or the Bureau of Standards staffs. An excellent instance of an important trade of which all members, great as well as small, have gained greatly by research work communicated to all alike, is that of the canners. The Canners' Association spends some £6,000 or £7,000 a year on its central laboratory, besides a good deal more on work done in the factories of individual members; and it is considered that the largest members have as much interest as the small in the results being made common to all, because the risk of the whole trade being discredited by imperfect production is thus minimized. Over a dozen universities and colleges, again, are now running laboratories devoted not only to investigations in pure science which may ultimately find a practical application, but to industrial researches for which the application is waiting as soon as the solution of the problems is found. In many instances such work is done not on the strength of foundations, but at the request and expense and for the benefit of commercial firms and other industrial bodies, such as railway companies.—London *Times*.

SCIENTIFIC BOOKS

Use of Mean Sea Level as the Datum for Elevations. (Special Publication No. 41.) By E. Lester Jones, Superintendent, U. S. Coast and Geodetic Survey, Washington, Government Printing Office. 1917.

This pamphlet presents a very strong case in favor of the adoption of a single datum for the elevations of the country in order to eliminate the confusion which results from the employment of arbitrary planes of reference.

There is scarcely any surveying or civil engineering which does not require that differences in elevation be determined by spirit leveling and in nearly all cases the absolute elevation of the bench marks above some plane of reference or datum is determined. Efficiency in operation frequently depends upon the datum selected. There are many other branches of science besides that of engineering in which absolute elevations are needed.

The selection of a fundamental datum is a matter of great importance. Only slight consideration leads one to conclude that the ideal datum for a nation is one which may be established at many places. The only one of this kind is mean sea level.

Mean sea level may be established within a very small fraction of a foot by continuous tidal observations for at least a year. It has been found from precise leveling observations that mean sea level, as established at different points on the open coasts, is at all such points in the same equipotential surface; that is, if there were no resistance of the water and wind to the movement of an object floating on the ocean, the object could be moved from one point on the coast to another without performing any work—there would be no lifting necessary. While this statement may not be absolutely true, yet it is so nearly the case that for all engineering and surveying purposes it may be accepted as rigidly true.

Mean sea level is used exclusively in the work of the Coast and Geodetic Survey and the U. S. Geological Survey. It is used to a certain extent by many other engineering bureaus of the government.

In December, 1916, the Coast and Geodetic Survey sent the following letter, or one similar to it, to the chief engineers of most of the large cities of the country, to the State Engineer of each state, and to the chief engineer of each of about 150 railroads in the United States:

> As you know, one of the important questions of the United States Coast and Geodetic Survey is the extension over the country of a network of precise leveling which will give elevations of great accuracy, based upon mean sea level.
>
> We believe that this precise leveling is essential in the surveying and engineering work done in this country by various public and private agencies. The network will enable engineers to use the sea-level datum on new projects and to reduce to this datum existing elevations referred to arbitrary datums. We believe that this country should eventually have but one datum, in order that all engineering and surveying work may be easily coordinated. We believe also, that the presence of various datums leads to much confusion and waste.
>
> In order that we may get into closer touch with the needs of the engineering profession, I should be glad if you will let me know to what extent your state is basing the elevations of its road and other surveys and engineering works upon mean sea level; also whether the use of various arbitrary datums by counties, cities and private organizations within your state is a serious matter in the industrial development of your state.

Replies were received from many of the engineers to whom the above letter was written. The opinions expressed were almost unanimously in favor of the adoption of mean sea level as the datum for elevations.

The pamphlet under discussion contains quotations from many of the letters received by the Survey. One of the quotations, typical of most of them, reads:

> So far as our experience has taught us there can be no question as to the desirability of a universal datum plane, and I think there can be no doubt in the minds of engineers engaged in municipal work that mean sea level is the only logical datum to adopt.
>
> In your advocacy of an extension of such bench marks you deserve the support and cooperation of every engineer in the country.

Another reads:

> We agree with you that it would be very valuable to the state if a system of levels could be established, and believe that such will need to be done in the near future in order to correlate the drainage, highway and other engineering work in the state.

It is realized by the members of the Coast and Geodetic Survey that much of the confusion in datums which now exist, is due to the fact that the precise level net of the United States was not extended in the past as rapidly

as it should have been. It, of course, was impossible, or rather impracticable, to extend a precise level net into areas through which railroads had not been run, for the expense would have been prohibitive. It may be that the Survey did not fully realize the necessity for having all engineering and surveying work on the same datum, but in recent years it has become fully alive to the necessity of having a single datum for the entire country, and it is consequently extending its precise leveling net as rapidly as funds available will permit.

While it is of value to the nation for various organizations and individuals to adopt and use mean sea-level datum for their elevations, the country will benefit still more if each organization doing extensive leveling will publish in pamphlet form the elevations and descriptions of the bench marks they may establish in order that other organizations and individuals may properly coordinate their levels. Engineers are urged also to use substantial bench marks in order that future work may be benefited by their preservation.

The amount of precise leveling which should be done by the federal government can not be foretold. It must depend upon the needs of the various organizations and individuals using the results. After a certain development of the precise level net which appears now to be absolutely necessary, the rapidity with which further extensions are made should depend upon the development of the country. But such further extensions should precede rather than follow such development, as is proved by the unfortunate condition of affairs in much of our engineering and surveying work, due to lack of precise elevations in the past, when such work was inaugurated.

This paper on mean sea level should, and no doubt will, do much good in furthering the universal adoption of mean sea level as the reference surface for all elevations.

The publication of such pamphlets by government organizations is to be commended, for they present facts to the public in an effective way which may otherwise be buried for years in valuable but more cumbersome government reports with which all of us are more or less familiar. William Bowie

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

The sixth number of volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

The stark effect in helium and neon: Harry Nyquist, Sloane Laboratory, Yale University. An improvement of Lo Surdo's method is applied.

New analyses of echinoderms: F. W. Clarke and R. M. Kamm, United States Geological Survey, Washington. A progressive enrichment in magnesia, following increase of temperature, is unmistakable.

On utilizing the facts of juvenile promise and family history in awarding naval commissions to untried men: C. B. Davenport, Station for Experimental Evolution, Carnegie Institution of Washington. A study with family charts of a number of naval officers.

The triplet series of radium: Gladys A. Anslow and Janet T. Howell, Department of Physics, Smith College.

The measurement of small angles by displacement interferometry: Carl Barus, Department of Physics, Brown University.

Mechanisms that defend the body from poliomyelitic infection, (a) external or extranervous, (b) internal or nervous: Simon Flexner, Rockefeller Institute for Medical Research. A report upon the results of recent experiments.

The occurrence of harmonics in the infrared absorption spectra of diatomic gases: James B. Brinsmade and Edwin C. Kemble, Jefferson Physical Laboratory, Harvard University. The discontinuities in the structure of these bands force the conclusion that the angular velocities are distributed among the molecules in the discontinuous manner predicted by the older form of the quantum theory, and the proved existence of harmonics is almost equally good evidence that the vibrational energy of the molecules is distributed in the same manner.

The loss in energy of Wehnelt cathodes by electron emission: W. Wilson, Research Laboratories of the American Telephone and Telegraph Company and of the Western Electric Company. The emission of the elec-

trons from Wehnelt cathodes is due to a similar mechanism to that causing the emission from heated pure metals.

Daily variations of water and dry matter in the leaves of corn and the sorghums: EDWIN C. MILLER, Kansas Agricultural Experiment Station. Under the conditions of these experiments the sorghums, and more particularly milo, absorb water from the soil and transport it to the leaves more rapidly in proportion to the loss of water from the plant than does corn; and thus the sorghums can produce more dry matter for each unit of leaf area under severe climatic conditions than can the corn plant.

Note on complementary fresnellian fringes: CARL BARUS, Department of Physics, Brown University.

The displacement interferometry of long distances: CARL BARUS, Department of Physics, Brown University. In preceding notes two methods for measuring small angles have been suggested. Application is here made to the determination of distances and is shown that an object at about a mile should be located to about thirty feet.

National Research Council: Meetings of the Executive Committeee and the Joint Meeting of the Executive, Military, and Engineering Committees. Report of the Astronomy Committee.

EDWIN BIDWELL WILSON
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SPECIAL ARTICLES

INTRA-VITAM COLOR REACTIONS

WE have slowly come to have great confidence in the specificity of certain physiological actions. We introduce into an organism certain substances, and definite results follow; but about the only thing we know in the matter is that the results follow with certainty. In such cases, if only we could see what it is that happens while it is happening, it seems certain that important advances would be made in our knowledge of nutrition, growth and decay—of physiology, pathology and medicine.

If substances giving color reactions in living tissues could be applied to small, transparent, varied and highly complex living organisms, under circumstances that would permit microscopic examination while the reactions are in progress, we might hope for more light on this exceedingly important subject. Experiments I have made lead to the belief that many of the conditions requisite for success in this line of investigation can be much more fully realized than hitherto by feeding colored substances, notably coal-tar dyes, to free-living nematodes.

These minute, transparent animals are comparatively highly organized; not only this, but also extremely varied in their mode of life. Some are exclusively vegetarian, others exclusively carnivorous, and others omnivorous. They constitute a group composed probably of hundreds of thousands of species, embodying an almost inconceivable number of kinds of physiological action. Their organs are enclosed in a thin transparent cuticle, and are strung out so as to make them unusually suitable for *intra-vitam* examination. Under slight pressure the nema flattens out more or less without losing its vitality sufficiently to preclude satisfactory *intra-vitam* examination under the highest powers of the microscope.

Observing certain precautions, I find that a great variety of coal-tar compounds and other colored compounds can be fed to nemas, apparently without interfering materially with their normal metabolism. I have had the best results by cumulative action, using small quantities of color dissolved in the medium in which the nema lived, and allowing the dye to act for days or weeks.

Not infrequently the dyes prove to be highly specific in their action. Only certain cells, or only definite parts of certain cells, exhibit visible reactions in the form of colorations. The results obtained by the use of any given dye may be quite varied. It is evident in many cases that the dye is digested and assimilated, thereby undergoing molecular changes by which it is converted into new compounds in a manner analogous to the processes exemplified in chemical laboratories devoted to the production of aniline dyes. Thus, a dye may give rise to several different colors, none of them like that of the dye itself, and all of them very

likely due to new compounds. Often I have seen considerable evidence pointing to the conclusion that in some cases the dyes fed are converted into colorless compounds during the process of digestion (a reduction phenomenon), and these colorless compounds reconverted into colored substances after they arrive at certain destinations or conditions. The number of changes these "living laboratories" can ring on the molecular structure of a given dye must in some cases be very considerable. Two or more dyes fed simultaneously sometimes produce results more or less independent of each other. The spectacles are very brilliant.

Using these methods I have been able to demonstrate within the confines of a single cell the existence of an unsuspected number of kinds of "granules," manifestly playing different rôles. After the differences among these bodies have been shown in this way, it is sometimes possible to perceive corresponding morphological differences; but without the aid of the color reactions the differences would never have been suspected.

The main thing to bear in mind is that on the basis of our present more complete knowledge of the chemical and physical properties of coal-tar-derivatives these color reactions in living nemas may be made the index of physiological characters possessed by cells and their components. In view of the great variety of the known coal-tar derivatives, and the great variety of physiological activities exemplified in the free-living nemas, it seems to me a very reasonable hope that researches directed along this line will lead to important results, and that the nemas may become classical objects in cell and general physiology, as they have already become in sex physiology.

A new and rather extensive nomenclature will become necessary. It will be needful to distinguish between the results of *intra-vitam*, *intra-mortem* and *post-mortem* staining; for these three terms represent as many different phases in the chemical reactions that take place during the course of the experiments. As the cells lose vitality, new color reactions occur, and the death of the cell is followed by further equally marked changes in the reactions.

The cell elements I have mentioned vary in size, but most of them are exceedingly small, many so small that they are on the limits of visibility, using the very best instruments with the greatest skill and under the most favorable conditions. On the other hand, some of them are large enough so that they can be examined in considerable detail and their structures made out. Among them are the bodies currently referred to under the name mitochondria and other more or less synonymous words.

As it will be some time before we can establish a rational nomenclature for these numerous intracellular structures, it is desirable meanwhile to adopt terms that will permit intelligent discussion of our discoveries as they are made. While the principles underlying such a nomenclature are easily defined, it is by no means easy, in the present condition of things, to suggest suitable short and expressive roots to be used as a basis. There will be less liability of confusion if the names first employed relate to form, size and position rather than to function.

Investigations of this character are not unlikely to stimulate further research in connection with aniline derivatives. Present efforts are directed toward the discovery of dyes of greater or less permanency. Permanency, however, is of little moment in these investigations; what is of moment is the chemical composition and physical properties of the dyes. No doubt dyes of a greater range of composition can be produced if permanency be disregarded. Furthermore, as already hinted, colorless compounds may be used in intra-vitam work if in the course of the metabolism they are converted into colored compounds. The results of recent studies of dies as chemical indicators come into play, and give valuable evidence in determining acidity and alkalinity.

I am almost ready to express the opinion that a small army of investigators should be engaged on the problems opened up in this way. The equipment needed by the investigator is as follows: He must be a very good

microscopist, versed in physiology, cytology and histology. He should be conversant with the chemistry of the coal-tar compounds, not so much from the viewpoint of the maker of dyes as from that of the broad-minded chemist, freed from the economic domination of the dye industry, for, as before remarked, fugitive dyes, and even colorless compounds, are possible factors in such investigations as are here under discussion. He should have a working knowledge of nemas.

ILLUMINATION

In order to distinguish with accuracy among *intra-vitam* color reactions it is necessary to be very particular about illumination. The most perfectly corrected lenses must be used, both as condenser and objective, and the light used must be as nearly white as possible. The best source of light known to me for these researches is bright sunlight reflected from a plane matte white reflector. The reflector should be several feet across, and placed at a distance from the microscope several times its own diameter. It should be universally adjustable, so that it can be set to reflect a maximum of light to the mirror of the microscope —all the better if heliostatic. A good surface for the screen is made by whitewashing a rather finely woven cotton cloth.

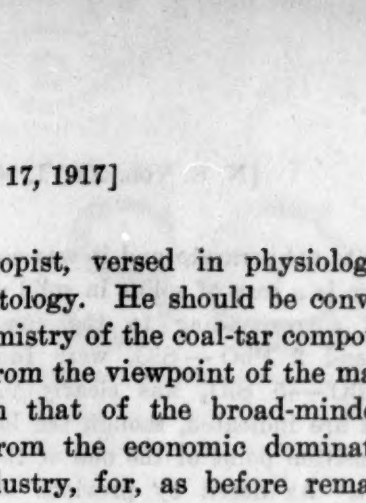

FIG. 1.

The best optical arrangement I have tried is the use of one apochromatic objective as a condenser for another apochromatic objective. I have been using with success a 2 mm. apochromatic as a condenser for a 2 mm. or 1.5 mm. apochromatic objective. These precautions are necessary if fine color distinctions are to be made with the greatest possible accuracy. If these precautions are taken it will be found that fine distinctions can be made with such precision as to dispel all doubt as to the existence, side by side, in the same cell of definite structures of varying character that it would otherwise be impossible or exceedingly difficult to distinguish from each other.

FIG. 2.

The use of an ordinary apochromatic objective as a condenser necessitates the use of a special object slide, consisting essentially of a carrier and two cover glasses. The object is mounted between the cover glasses. Such a slide is shown in the accompanying illustration. The substage of the microscope should have a centering arrangement and a rack and pinion or screw focusing adjustment. A little experience with an apparatus of this sort, in which all known precautions are taken to remove color from the optical system, leads one to distrust the ordinary Abbé substage condenser where fine distinctions are to be made between colors, especially if the colors are of similar character.

N. A. COBB

U. S. DEPARTMENT OF AGRICULTURE

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

H. P. Talbot, *Chairman*

E. B. Millard, *Secretary*

The positive and negative specific heat of saturated vapors: F. P. SIEBEL. A vapor expanding from a temperature T to the temperature $T-1$ reversibly, yields the maximal work W due to the latent heat of vaporization H introduced at the higher temperature in accordance with the second law expressible in equivalent calories as

$$W = H\frac{T-(T-1)}{T} = \frac{H}{T} \text{ calories.}$$

This amount of work is in many cases greater than

the difference in the total heat of the vapor L between the temperatures T and $T-1$ degrees absolute, viz., $L-L_0$ and in this case an amount of heat equal to $H/T=(L-L_0)$ must be added to maintain the vapor in a saturated condition, and it is therefore called the "negative specific heat" at the temperature T. If $L-L$ is greater than H/T the difference of heat must be added and it is then called "positive specific heat." The examples show that all the numerical values in this respect determined by Clausius on a somewhat different basis agree perfectly with those obtained after the above formula, which agreement, however, is not found with other results obtained by other authors on a similar basis, apparently due to errors of judgment so liable in the application of the calculus. Moreover, it is argued that instead of the heat quantity H/T which represents the net work when the expansion takes place in a reversible cycle, the heat quantity W_e representing the maximax work in reversible expansion should be used, which changes the values of positive and negative heat slightly.

The separation of erbium from yttrium: B. S. Hopkins and Edward Wichers. The erbium-yttrium material used in the investigation was obtained by fractional crystallization of the bromates. Methods recommended by Drossbach and Wirth could not be duplicated with the success obtained by these workers. Cobalticymide precipitation as recommended by James, was found to give a good separation, but offered practical difficulties. Precipitation with sodium nitrite as used by Hopkins and Balke found to give a rapid separation when used with material which was predominantly yttrium.

A study of the ratio of Er_2O_3:2 $ErCl_3$: C. W. Balke and Edward Wichers. A brief discussion of other ratios used in determining the atomic weights of the rare earth elements was given and the constancy of composition of the rare earth sulphates questioned. The method of applying the oxide-chloride ratio to erbium was described and data given which give an atomic weight approximately one unit higher than the present value.

A thermal study of some members of the system $PbO-SiO_2$: L. I. Shaw and B. H. Ball. Many mixtures of PbO and SiO_2 varying in composition from 40 per cent. to 90 per cent. PbO were melted in an electric furnace and the records of their thermal conduct plotted on time-temperature diagrams. (In some cases PbO_2 was used instead of PbO and its behavior is noted.) The significant temperatures of these graphs were then combined into a composite temperature and it was concluded that the system is a case of solids in solid solution. Two maxima corresponding to the composition $PbO-SiO_2$ and 2 $PbO-SiO_2$ were found and another 2 $PBO-5$ SiO_2 was clearly indicated. Two eutectics are indicated, though the lower one may be a transition point of the one of the higher melting point. As noted by previous investigators, a transition point of SiO_2 was found at 540°–580° C. All mixes sintered at 690° ± 10° C.

A study of the change of conductivity with time in the system methyl alcohol-iodine-water: L. I. Shaw and John P. Trickey. Conductivities of solutions of iodine in methyl alcohol of various boiling points have been measured. It was found that the conductivity increased much more rapidly in the case of the solutions in alcohol of higher boiling points; also, that the conductivity reached a higher value in the case of the solutions from the higher boiling point alcohols. It was suggested that this was probably due to the water content of the alcohol. It was found that a smooth curve could be drawn through the points at which the conductivity of the various solutions became constant. Suggestions as to the probable reaction were given.

The solubility of pure radium sulfate: S. C. Lind, C. F. Whittemore and J. E. Underwood. The solubility of $RaSO_4$ in water and other solutions is of practical interest since all processes for the recovery of radium from its ores involve, at some stage, the precipitation of radium together with barium as sulfate.

Studies in pseudo-isotopy—Part I: S. C. Lind. Experiments of the author and others have shown that when radium and barium are partially precipitated from a solution containing a mixture of the two, no change in relative concentration takes place. This is true for sulfate, oxolate, carbonate, and perhaps all other difficulty soluble salts, and bears an exact analogy to the inseparability of the isotopic elements. The fact that radium and barium are only *pseudo*-isotopic, however, is shown from the great divergence of their atomic numbers, and their ready separation by recrystallization of the chlorides or bromides. It has been shown in the preceding paper that the assumption of identical solubility of $RaSO_4$ and $BaSO_4$ in analogy to their pseudo-isotopic action in precipitation reactions, is far from the truth. Conversely, this must raise the question, from the purely experimental side, as to the truth of the assumption generally made of identical solubility of true isotopes.